

Before the  
**FEDERAL COMMUNICATIONS COMMISSION**  
Washington, DC 20554

In the Matter of	)	
	)	
Spectrum Horizons	)	ET Docket No. 18-21
	)	
James Edwin Whedbee Petition for	)	RM-11795
Rulemaking to Allow Unlicensed Operation	)	
in the 95-1,000 GHz Band	)	

**REPLY COMMENTS OF the mmWAVE COALITION**

The mmWave Coalition (“mmWC” or the “Coalition”)<sup>1</sup> hereby files these Replies to comments filed in response to the Notice of Proposed Rulemaking<sup>2</sup> (“Notice” or “NPRM”) in the above-captioned proceeding. The record in this proceeding demonstrates a general consensus around adopting licensed service rules along the lines of those proposed in the *Notice* but with some modifications to the rules that will allow wider deployment of wireless networks. The record also reflects a broad consensus around more flexible experimental license rules as discussed in the *Notice*. Finally, the record reflects support for extending the existing RF safety limits for frequencies above 100 GHz up to 300 GHz.

---

<sup>1</sup> The mmWave Coalition is a group of innovative companies united in the objective of removing regulatory barriers to technologies and using frequencies ranging from 95 GHz to 275 GHz. Members of the Coalition include American Certification Body, Azbil North America Research & Development, GLOBALFOUNDRIES U.S., Keysight Technologies, Nokia, Nuvotronics, Qorvo, RaySecur, and Virginia Diodes. Principals of the Coalition are listed in an Attachment to the Coalition’s Comments filed in this proceeding on May 2, 2018.

<sup>2</sup> *Spectrum Horizons; James Whedbee Petition for Rulemaking to Allow Unlicensed Operation in the 95-1000 GHz Band*, ET Docket No. 18-21, RM-11795, Notice of Proposed Rulemaking and Order, FCC 18-17 (rel. Feb. 28, 2018) (“NPRM”).

The above-95 GHz spectrum is promising for a variety of new technologies and uses, including fixed wireless access to replace or complement fiber to the home (including timely restoration of high-capacity fiber links damaged during natural disasters or other situations), wireless backhaul, mobile broadband, sensing, industrial automation, and high capacity wireless links for IoT links and AR/VR.<sup>3</sup> The Coalition urges the Commission to move quickly to adopt a regulatory framework to provide certainty and spur investment in such technologies, and looks forward to working with the Commission and other stakeholders to make above-95 GHz spectrum more accessible and useful for these and other innovative services and technologies.

**I. THE COMMISSION SHOULD ADOPT CERTAIN CHANGES TO THE PROPOSED LICENSED SERVICE RULES IN ORDER TO FACILITATE TECHNOLOGIES AND SERVICES THAT UNLOCK THE POTENTIAL OF THE ABOVE-95 GHz mmWAVE SPECTRUM**

The record in this proceeding reflects strong support for modifications to the broad licensing provisions proposed by the Commission to allow greater flexibility for wireless network deployment in the above-95 GHz frequencies. Several commenting parties support rules that allow point-to-multipoint operations in addition to the point-to-point operations proposed in the *Notice*,<sup>4</sup> and mmWC encourages the Commission to

---

<sup>3</sup> See, e.g., Monica Allevan, *DARPA Project to Examine Terahertz for Wireless Communications*, May 11, 2018, at <https://www.fiercewireless.com/wireless/darpa-project-to-examine-terahertz-for-wireless-communications>.

<sup>4</sup> Comments of CTIA at 7 (“CTIA Comments”); Comments of Facebook, Inc. at 4-5 (“Facebook Comments”); Comments of QUALCOMM Incorporated at 7-10 (“QUALCOMM Comments”); Comments of Starry, Inc. at 3 (“Starry Comments”). Unless otherwise stated, all Comments cited to herein were filed in ET Docket No. 18-21 on May 2, 2018.

also explore other options, as mentioned in the *Notice*,<sup>5</sup> that would allow licensees to register operations in an area around a fixed location to promote innovative and affordable broadband service.

Several parties also agree with mmWC that the Commission should consider the eventual use of the above-95 GHz spectrum for mobile services.<sup>6</sup> In this regard, mmWC recommends that the Commission make clear that the usual approach of “first-in-time” rights to the spectrum by fixed services will not preclude later use of the above-95 GHz spectrum for mobile operations under appropriate service rules.<sup>7</sup> The Coalition also agrees that the Commission should prioritize making spectrum available for services for which there is a demonstrated need for additional spectrum, such as spectrum for wireless backhaul and other terrestrial wireless services, while maintaining flexibility to accommodate other uses in the future depending on technological and other developments.<sup>8</sup>

The record also reflects strong support for less restrictive technical rules, including higher transmitted power limits and no minimum (or a lower minimum) antenna gain.<sup>9</sup> The technical rules adopted in this proceeding should permit a wide range of antenna deployments in order to maximize flexibility in network topologies.

---

<sup>5</sup> *NPRM* at 19, ¶ 38.

<sup>6</sup> Comments of T-Mobile USA, Inc. at 6 (“T-Mobile Comments”); CTIA Comments at 4-5.

<sup>7</sup> T-Mobile Comments at 6.

<sup>8</sup> *Id.* at 12-13.

<sup>9</sup> CTIA Comments at 6-7; T-Mobile Comments at 7-9; Comments of Ericsson at 15-17 (“Ericsson Comments”).

The Coalition agrees with the parties who urge the Commission to promote sharing of spectrum between commercial and government spectrum users, with appropriate restrictions as needed to protect Radio Astronomy Service (“RAS”), Earth Exploration-Satellite Service (“EESS”), and other passive users.<sup>10</sup> As noted in the record, passive RAS locations are well defined and limited to a finite number of locations across the United States, typically remote from large population centers.<sup>11</sup> Thus, even with appropriate restrictions on licensed services in the vicinity of these RAS locations, high-capacity wireless services can be provided in much of the country without posing any risk to RAS.<sup>12</sup> While EESS and other earth remote sensing may present different challenges, T-Mobile has explained that such services can be protected by implementing modest operating constraints on licensed services without categorically excluding all other licensed services from the relevant spectrum.<sup>13</sup> The Coalition urges the Commission to adopt appropriate rules, including revising the present text of US246 as it has done in the past, to protect passive RAS and EESS operations from interference based on ITU Recommendations and other accepted criteria.<sup>14</sup>

---

<sup>10</sup> Comments of the Consumer Technology Association at 8 (“CTA Comments”); CTIA Comments at 9-12; Ericsson Comments at 17-18; Comments of Google LLC at 3 (“Google Comments”); QUALCOMM Comments at 5-7; T-Mobile Comments at 11-12.

<sup>11</sup> Comments of the National Academy of Sciences’ Committee on Radio Frequencies at 14-15 (filed Mar. 30, 2018) (“CORF Comments”); Comments of National Radio Astronomy Observatory at 1 (filed Apr. 2, 2018).

<sup>12</sup> T-Mobile Comments at 11-12; CTIA Comments at 9-10; Ericsson Comments at 17-18; *see also* CORF Comments at 16 (noting that fixed terrestrial use can be coordinated with RAS).

<sup>13</sup> T-Mobile Comments at 11-12 and n.42.

<sup>14</sup> For example, the National Academy of Sciences’ Committee on Radio Frequencies cites three ITU Recommendations that contain criteria for protecting passive RAS and EESS systems: ITU-R RA.769-2, Protection criteria used for radio astronomical

Ultimately, it is vital for the Commission to work with NTIA to establish appropriate criteria that protect passive users while still allowing expanded wireless use of the above-95 GHz frequencies. Under the current proposal, the maximum authorized bandwidth for licensed services is 7.5 GHz, with several of the balkanized bands permitting a maximum bandwidth of 1 GHz and under.<sup>15</sup> In contrast, as the Commission observed in the *Notice*, Japan's Ministry of Internal Affairs and Communications has made an 18 GHz-wide band available at 118-134 GHz.<sup>16</sup> Particularly given the propagation characteristics of the higher-band frequencies, the rules proposed in the NPRM fail to take advantage of the almost 200 GHz of spectrum between 95 GHz and 275 GHz and, indeed, do not provide much incentive for fixed wireless deployments when comparable maximum bandwidth blocks are available at lower frequencies. Some of the proposed bands are so narrow — *e.g.*, 300 MHz at 174.5-174.8 GHz and 500 MHz at 231.5-232 GHz — that it is questionable as to whether anyone will design and/or invest in equipment to access such small bandwidths. Therefore, as mmWC and others have stated, the Commission should establish sharing criteria that permit licensed services in large contiguous blocks of spectrum rather than categorically limit all operations in frequencies used by passive users.<sup>17</sup>

---

measurements (2003); ITU-R RS.2017-0, Performance and interference criteria for satellite passive remote sensing (2012); and ITU-R RS.1858, Characterization and assessment of aggregate interference to the Earth exploration-satellite service (passive) sensor operations from multiple sources of man-made emissions (2010).

<sup>15</sup> NPRM at 54-55, Proposed Section 101.109(c).

<sup>16</sup> *Id.* at 9, ¶ 12.

<sup>17</sup> Google Comments at 3; CTA Comments at 8; CTIA Comments at 9-12; Ericsson Comments at 17-18; QUALCOMM Comments at 5-7; T-Mobile Comments at 11-12.

## **II. THE RECORD REFLECTS GENERAL CONSENSUS IN SUPPORT OF MORE FLEXIBLE EXPERIMENTAL LICENSE RULES**

The comments filed in response to the *Notice* reflect strong support for the proposed rules for Spectrum Horizons Experimental Radio Licenses.<sup>18</sup> These proposed rules offer greater flexibility than the existing rules by, for example, permitting wider marketing of equipment, allowing experimental licenses across the entire 95 GHz-3 THz range, allowing a broad scope for experimental licenses, and establishing a ten-year license term.<sup>19</sup> The Coalition also supports Google's call for the Commission to invest in engineering and other resources to ensure that it is prepared to review and approve experimental license applications expeditiously.<sup>20</sup> Finally, mmWC urges the Commission to adopt procedural safeguards as discussed in its initial Comments<sup>21</sup> in order to facilitate funding for innovative technologies and services above 95 GHz.

## **III. THE COMMISSION SHOULD EXTEND RF SAFETY LIMITS ABOVE 100 GHZ**

As explained in its comments, mmWC urges the Commission to extend RF Safety limits to frequencies above 100 GHz in order to provide regulatory certainty to developers and providers of technologies and services operating in the above-95 GHz frequencies.<sup>22</sup> The absence of a specific RF safety limit makes it impossible for operators and manufacturers to point to compliance with an applicable FCC RF safety limit when

---

<sup>18</sup> Facebook Comments at 5; Google Comments at 4-7; Comments of IEEE 802 LAN/MAN Standards Committee at 2-3; Starry Comments at 8; Comments of the Telecommunications Industry Association at 2-4.

<sup>19</sup> *NPRM* at 31-35, ¶¶ 70-81.

<sup>20</sup> Google Comments at 7.

<sup>21</sup> mmWC Comments at 9-11.

<sup>22</sup> *Id.* at 11-12.

faced with zoning/permitting issues from local governments or in litigation over possible health impacts of such systems. Several parties agree with this approach, citing the benefits of regulatory certainty<sup>23</sup> and the fact that the EU is ahead of the US in part because it has in place RF safety limits that extend up to 300 GHz.<sup>24</sup>

The Coalition also noted in its comments that the existing RF exposure limits up to 100 GHz are based on an IEEE standard that extends to 300 GHz.<sup>25</sup> Accordingly, mmWC urges the Commission to adopt an interim standard by extending the current 100 GHz RF Exposure limit to frequencies above 100 GHz — even if such limits are later modified in a separate proceeding — to encourage investment in and reduce litigation risk for new technologies developed for use in the above-95 GHz spectrum.

#### **IV. THE COMMISSION SHOULD PROVIDE REGULATORY CERTAINTY FOR INDUSTRIAL, SCIENTIFIC, AND MEDICAL (ISM) USES OF ABOVE-95 GHZ SPECTRUM**

The Coalition urges the Commission to foster regulatory certainty for ISM operations in the above-95 GHz frequencies.<sup>26</sup> Professor Mittleman notes that low-power short range systems operating in the above-95 GHz frequencies are “already being used in commercial settings for sensing, imaging, package inspection, security, and quality control, in a variety of manufacturing and process environments, both in the US and overseas, as well as in many basic scientific studies involving spectroscopy

---

<sup>23</sup> QUALCOMM Comments at 11-12; CTA Comments at 9.

<sup>24</sup> Comments of Professor Daniel Mittleman at 6-7 (“Prof. Mittleman Comments”).

<sup>25</sup> mmWC Comments at 12 (citing American National Standards Institute (ANSI), *IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz*, ANSI/IEEE Std C95.1-1992, Sections 4.1 and 4.2).

<sup>26</sup> mmWC Comments at 12-13.

and imaging.”<sup>27</sup> Technologies such as terahertz spectroscopy are being used for a variety of non-communications industrial and defense applications.<sup>28</sup> However, as Professor Mittleman explains, much of the research and development in these frequencies is occurring outside the United States in part because of the lack of regulatory clarity in the U.S.<sup>29</sup> Providing regulatory certainty for such uses will encourage capital formation for both developers of new innovative ISM equipment and manufacturers who use the technology in their manufacturing processes.

**V. THE COALITION SUPPORTS A FLEXIBLE APPROACH TO TESTING AND MEASUREMENT THAT EVOLVES AS THE COMMISSION PROVIDES GUIDANCE INFORMED BY STANDARDS-SETTING ORGANIZATIONS AND INDUSTRY INPUT**

As the Coalition explained in its Comments, mmWC supports a flexible approach to testing and measurement wherein OET provides guidance on appropriate testing and measurement techniques through its knowledge database publications as products are developed, seeking industry input as appropriate. The Coalition also refers the Commission to recently filed comments by Coalition member Keysight Technologies for further perspectives and guidance on testing and measurement for equipment operating in the above-95 GHz frequencies, including applicable IEEE Standards and ongoing efforts by NIST and others to develop measurement techniques

---

<sup>27</sup> Prof. Mittleman Comments at 3.

<sup>28</sup> See, e.g., Ergün, Salih & Sönmez, Selçuk. *Terahertz Technology For Military Applications*. Journal of Military and Information Science (Jan. 2015), available from [https://www.researchgate.net/publication/277579565\\_Terahertz\\_Technology\\_For\\_Military\\_Applications](https://www.researchgate.net/publication/277579565_Terahertz_Technology_For_Military_Applications); see also NASA Technology Transfer Program, *Terahertz Tools Advance Imaging for Security, Industry*, at [https://spinoff.nasa.gov/Spinoff2010/ps\\_8.html](https://spinoff.nasa.gov/Spinoff2010/ps_8.html).

<sup>29</sup> Prof. Mittleman Comments at 5-7.



for the above-95 GHz frequencies.<sup>30</sup>

\* \* \*

The mmWave Coalition commends the Commission for initiating this important proceeding and looks forward to working with the Commission and other interested parties to help establish rules that facilitate the introduction of innovative services and technologies in the above-95 GHz frequency bands.

Respectfully submitted,

**The mmWAVE COALITION**

/s/\_\_\_\_\_  
Henry Goldberg  
Devendra T. Kumar  
*Its Attorneys*  
Goldberg, Godles, Wiener & Wright LLP  
1025 Connecticut Avenue NW  
Suite 1000  
Washington, DC 20036  
(202) 429-4900

*Technical Advisor*  
Michael J. Marcus  
**Marcus Spectrum Solutions LLC**  
+1-301-229-7714  
[www.marcus-spectrum.com](http://www.marcus-spectrum.com)

May 17, 2018

---

<sup>30</sup> Comments of Keysight Technologies, Inc. (filed May 14, 2018).